Name ___________________________ Test 4 (12/8)

CHEM 0211 (Adv Inorganic) Fall 2010

1. ________
2. ________
3. ________
4. ________
5. ________
6. ________
7. ________
8. ________

1. a. (8 pts.) Provide names for the following compounds.

   b. (8 pts.) Determine whether the transition metals are d^1, d^2, d^3, etc.

i. $[Pd(NH_3)_4Cl_2]$

a.

b. ______________________________________

ii. $Na_2[CuCl_4]$

a.

b. ______________________________________

2. a. (8 pts.) Draw the structural formulas (formulas like the ones above) for the following complexes.

   b. (8 pts.) Determine whether the transition metals are d^1, d^2, d^3, etc.

   c. (8 pts.) Draw structures for the following coordination compounds. Draw only the ligands that are directly coordinated to the metal.

i. *fac*-tricarbonyltrichlororhenium(I)

a.

b. ______________________________________

octahedral

c.

ii. pentaaquachlorochromium(III) chloride

a.

b. ______________________________________

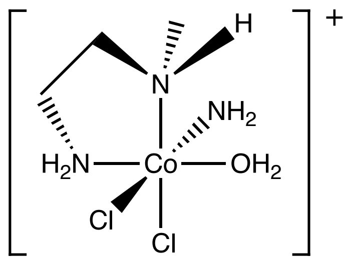
octahedral

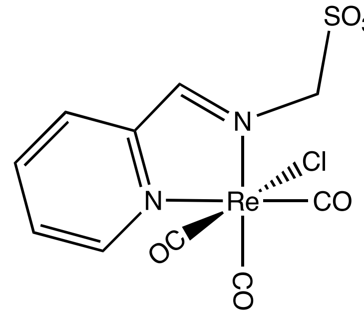
c.

3. a. (6 pts.) Draw as many stereoisomers of $[Pd(NH_3)_4Cl_2]$ as are possible.

   b. (4 pts.) Label the stereoisomers with the appropriate label (*cis*, *trans*, *fac*, *mer*, etc.).

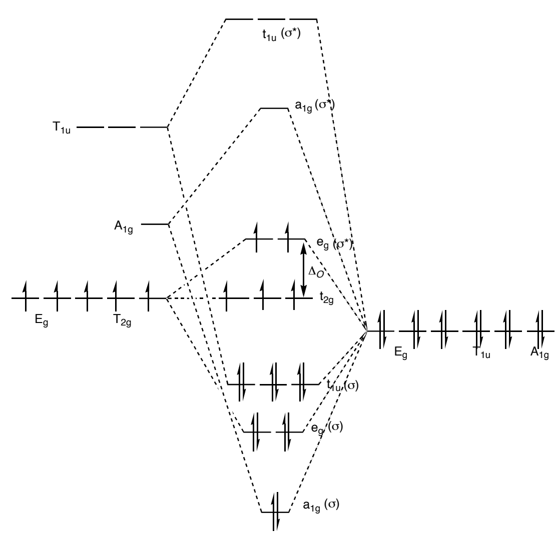
4. (10 pts.) Place a star next to any chiral atoms and circle any other sources of chirality that exist on the complexes drawn below.





5. (10 pts.) In crystal field theory, the energies of the metal d orbitals are no longer degenerate when placed in an octahedral electric field; that is, some of the orbitals have different energies when the metal is at the center of an octahedron of electron donors. Describe the interactions that causes the e_g set of orbitals to be higher in energy than the t_{2g} set of orbitals. In your description, remember to identify which d orbitals are included in the e_g set and which are included in the t_{2g} set.

6. a. (6 pts.) An MO diagram for a metal ion interacting with six σ donors is drawn on the right. A significant shortcoming of Crystal Field Theory is that it makes no effort to explain why complexes form. Ligand Field Theory, on the other hand, does provide an explanation for the formation of metal-donor complexes. How does Ligand Field Theory provide an explanation for why the complex forms?



b. (6 pts.) Would this metal be called a high-spin or a low-spin metal complex? Explain your response by describing what the opposite case would look like.

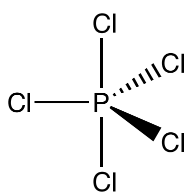
c. (6 pts.) Explain why there are three e⁻'s in the t_{2g} orbitals and two e⁻'s in the e_g orbitals instead of five electrons in the t_{2g} orbitals in this particular complex.

7. Although not often used with transition metals, the valence bond or hybridization model is still used to describe some inorganic compounds.

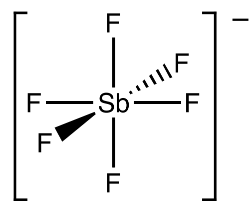
a. (8 pts.) Determine the hybridization of the P and Sb atoms in the following molecules.

b. (8 pts.) List the orbitals, along with their principle quantum numbers (e.g. 2s, 2p, 3d, etc.) that would be used to form the hybrid orbitals in part a.

i.



ii.



8. As shown in the MO diagram on the previous page, σ donors tend to push up the energy of the e_g set of metal-centered molecular orbitals. What effect do (a. 6 pts.) π-acceptors and (b. 6 pts.) π-donors have on the metal-centered e_g and t_{2g} sets of orbitals.

9. a. (6 pts.) Draw a graphical representation of the orbitals on a halide ion acting as a π-donor to a metal ion and
b. (6 pts.) briefly explain the diagram.

10. (3 pts. each) Determine whether the following molecules or ions are σ-donors, π-donors, π-acceptors, or some combination of the three.

$C\equiv O$	$C\equiv N^-$	$P(CH_3)_3$	Br^-	$N(CH_3)_3$